ARLINGTON
VIRGINIA

DEPARTMENT OF ENVIRONMENTAL SERVICES
Office of Sustainability and Environmental Management

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June 17, 2015

Mr. Bryant Thomas
Water Permits and Planning Manager
Virginia Department of Environmental Quality
13901 Crown Court
Woodbridge, VA 22193

Dear Mr. Thomas,

Arlington County is pleased to submit the attached Chesapeake Bay Total Maximum Daily Load (TMDL) Action Plan, as required by Arlington County's Municipal Separate Storm Sewer System (MS4) Permit, VA0088579.

If you have any questions or need additional information, please contact me at (703) 228-3613 or jpapacosma@arlingtonva.us .

Sincerely,

Jason Papacosma
Watershed Programs Manager

Cc: Greg Emanuel, Director, Department of Environmental Services
Jeff Harn, Chief, Office of Sustainability and Environmental Management
Susan Mackert, Water Permit Writer, DEQ

Virginia Stormwater Management Program (VSMP) Permit No. VA0088579

Arlington County Chesapeake Bay TMDL Action Plan

ARLINGTON
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2013 – 2018 Permit Cycle
Submitted June 2015

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Overview

This Chesapeake Bay Total Maximum Daily Load (TMDL) Action Plan is developed to meet the requirements of by Part I.D of Arlington County's Municipal Separate Storm Sewer System (MS4) Permit, VA0088579, issued June 26, 2013. The permit requires this Action Plan to document a minimum 5.0% reduction during this 5-year permit cycle of the total Bay TMDL pollutant of concern (POC) reductions required for Arlington County's MS4 service area.

The numbered sections in this Action Plan correspond with the numbered sections in Part VI of the DEQ Chesapeake Bay TMDL Special Condition Guidance document, items 1 through 10, issued by the Virginia Department of Environmental Quality (DEQ) and relied upon by Arlington in developing this plan. Letters in parentheses track Arlington's MS4 permit, Section I.D.1.b.1, items a through l.

1. Current Program and Existing Legal Authority (a)

Arlington has reviewed its current MS4 Program Plan and has determined that the authority as stated in the current MS4 Program Plan is sufficient for compliance with this special condition. Please refer to the MS4 Program Plan at Section A.2, pp. 4-6, for a list of relevant existing legal authority.

2. New or Modified Legal Authority (b)

As described in item 1 above, existing authority is sufficient for compliance with this special condition. Therefore, no new or modified legal authority beyond that described in the MS4 Program Plan at Section A.2, pp. 4-6, is considered necessary to meet the requirements of this special condition.

3. Means and Methods to Address Discharges from New Sources (c) and 6. Means and methods to offset increased loads from new sources initiating construction between July 1, 2009 and June 30, 2014 (g)

This section describes Arlington's comprehensive and conservative accounting methodology addressing all regulated development activity within Arlington's MS4 Service Area in accordance with DEQ's VSMP Regulations and Arlington's Stormwater Management Ordinance. Most development activity in Arlington is redevelopment with less than one (1) acre of land disturbance. Arlington is applying TMDL POC load reduction credit for all redevelopment activity that disturbs at least 2,500 square feet of land (the regulatory threshold set for Chesapeake Bay Preservation Act localities). For full accounting for pollutant load changes associated with all regulated development activity within Arlington's MS4 Service Area, whether new development or redevelopment and whether land disturbance exceeded the one (1) acre threshold or not, the County applied the accounting methodology described below under 3.A. This methodology is more conservative than required by the County's MS4 permit because it includes new development with less than

one (1) acre of land disturbance—which is below the regulatory threshold. This aggregate accounting methodology is consistent with Appendix II (Example II.2) of the DEQ Chesapeake Bay TMDL Special Condition Guidance.

Applying the aggregate accounting methodology as shown in Table 1. below, the projects subject to "new source" requirements and potential offsetting generated a net POC reduction for this time period. Therefore, no offsets are required to achieve compliance with this condition.

A. July 1, 2009, to June 30, 2014:

For all regulated development and redevelopment activity within Arlington County (≥2,500 square feet of land disturbance) and not located on a Permitted facility or on State/Federal Property[1]:

- Sum pre-development impervious and pervious area and compute TP, TN, and TSS loading rates using MS4 permit loading table.
- Sum post-development impervious and pervious area and compute TP, TN, and TSS loading rates using MS4 permit loading table.
- Compute TP, TN, and TSS load change (increase or decrease) associated with land use change.
- For BMPs[2] associated with regulated development activity:
    - Compute TP, TN, and TSS loads to each BMP using MS4 permit loading table.
    - Determine whether BMP was designed for 0.5" or 1" water quality volume (WQV) and whether BMP is RR or ST system.
    - Apply 0.5" or 1" WQV value to RR or ST Retrofit Adjustor Curves to determine TP, TN, and TSS removal efficiencies.
    - Apply removal efficiencies to loads to BMP
    - Determine TP, TN, and TSS loads removed by BMP
    - For proprietary systems where a WQV design value was not explicitly provided, the runoff depth treated was determined that, when used with the TP curve, produced the TP removal efficiency for the BMP published in the clearinghouse. This depth was then used with the TN and TSS ST Retrofit Adjustor Curves to determine the TN and TSS removal efficiencies.

[1] For purposes of this accounting element, load increase for regulated activities not located on a Permitted facility or on State/Federal Property have been assumed by Arlington County whether or not in the County's MS4 service area, along with the corresponding credit for BMP load removal.

[2] In its policies, specifications, reports, and plans, the County uses the term 'stormwater management facility' (SWMF) to describe engineered systems that provide stormwater pollutant removal, rather than the term 'Best Management Practice' or 'BMP.' However, in this document, the term 'BMP' is used for consistency with the terminology in the DEQ Chesapeake Bay TMDL Action Plan guidance document.

Compute net TP, TN, and TSS load change (increase or decrease) by comparing total BMP loads removed with total load change associated with regulated development	Pollutant	Existing Development Conditions for Projects from 7/1/2009 to 6/30/2014 Acres	2009 EOSLoading Rate (lbs/ac)	Load	Post Development Conditions for Projects from 7/1/2009 to 6/30/2014 Acres	2009 EOSLoading Rate (lbs/ac)	Load	Load Increase	Total Load Increase	Reduction from BMPs drain to MS4	Reduction from BMPs that do not Drain to MS4	Difference
Regulated Urban Impervious		124.30	16.86	2095.72	147.56	16.86	2487.90	392.18	157.94	298.00	6.77	
Regulated Urban Pervious	Nitrogen	184.61	10.07	1859.01	161.35	10.07	1624.77	-234.24				-146.83
Regulated Urban Impervious		124.30	1.62	201.37	147.56	1.62	239.05	37.68	28.15	35.66	0.67	
Regulated Urban Pervious	Phosphorus	184.61	0.41	75.69	161.35	0.41	66.15	-9.54				-8.19
Regulated Urban Impervious		124.30	1171.32	145596.38	147.56	1171.32	172842.45	27246.07	23156.79	29810.03	502.78	
Regulated Urban Pervious	Total Suspended Solids	184.61	175.80	32454.24	161.35	175.80	28364.96	-4089.28				-7156.02

Table 1. Load Changes from Sources initiating Construction between July 1, 2009, and June 30, 2014 with Load Reductions for BMPs

Table 1. includes projects where construction was completed between July 1, 2009 and June 30, 2014. Projects that started construction, but were not completed before June 30, 2014, will be computed using the same methodology described here and accounted for in the post June 30, 2014 accounting.

See Appendix B for computations for BMP loads removed.

B. Post June 30, 2014:

For all development activity regulated under the new VSMP regulations and local ordinance[3] constructed after June 30, 2014, the methodology described in 3.A[4] above will be used with the following modifications:

- New development activity will accounted for as nutrient and sediment neutral, per Part VI.3 of the DEQ Chesapeake Bay TMDL Special Condition Guidance.
- For redevelopment activity:

[3] Development activity regulated under the previous local ordinance but completed after July 1, 2014, will be accounted for as described in 3.A.

[4] Note that the Runoff Reduction Method loading rates differ from the permit loading rates and therefore the methodology in 3.A will be used for consistency with the permit.

- Removal efficiencies from the BMP Clearinghouse will be used for TP and TN.
- Removal efficiencies for TSS for will be derived from the TSS Retrofit Adjustor Curve using runoff depth treated of 1" for Level I systems and 1.25" for Level II systems.[5]
- For proprietary systems, which do not have Clearinghouse removal efficiencies for TN or TSS, removal efficiencies for TN and TSS will be determined as follows:
  - The runoff depth treated that, when used with the TP curve, produces the TP removal efficiency for the BMP published in the clearinghouse will be determined.
  - This depth will then be used with the TN and TSS ST Retrofit Adjustor Curves to determine the TN and TSS removal efficiencies.

Please note that, because FY 2015 is not yet completed, the 'Post June 30 2014 data' will be reported starting with the FY 2015 annual report.

Linear development projects conducted by the County will be administered and tracked as follows consistent with 9VAC25-870-69.A.4, 9VAC25-870-76, and 9VAC25-870-92 upon approval of this Plan:

- Pollutant load changes will be computed as described in 3.A.
- Retrofit opportunities will be evaluated for each project, using the screening and selection criteria applied and described in the adopted Stormwater Master Plan.
- Retrofit projects that meet the screening criteria and are determined by Arlington to be feasible and cost-effective will be implemented with specific linear development projects. Pollutant load reductions from retrofit projects will be computed as described in Section 5.
- In cases where retrofit projects are not feasible and cost-effective for a particular linear project, any POC load increases that might occur for that project will be addressed by larger overall POC load reductions in place or added through TMDL action plan implementation.

In the above manner Arlington, as the MS4 operator and the construction site operator for its linear development projects, will implement linear projects and retrofit projects in a manner that achieves the most TMDL POC reduction for the

[5] Note that this is conservative because the depth treated includes pervious and impervious drainage area. Actual runoff depth treated for only impervious area treated will be higher when the drainage area also includes pervious lands.

least cost, while fully accounting for load changes that occur with linear development project activity consistent with the DEQ Chesapeake Bay TMDL Special Condition Guidance.[6]

4. Estimate Existing Sources Loads and Calculated Total Pollutant of Concern (POC) Required Reductions for the Potomac River Basin (d) and (e)

Existing sources for Arlington County have been determined using Planimetric data developed from Ortho-rectified Aerial Photography taken in 2009. Polygons for impervious surfaces include the following:

1. Structures – excludes most outbuilding less than 100 square feet
2. Bridges – roadway and pedestrian
3. Airport runways
4. Alleys
5. Driveways
6. Parking lots
7. Paved Medians
8. Roadways
9. Sidewalks – including handicap ramps, and bike/pedestrian trails (excludes most lead walks and patios in residential areas. See additional information below.)
10. Hard surface sports courts including but not limited to: tennis, handball and basketball

To determine the amount of impervious area associated with lead walks and patios in single family residential areas three samples sites were selected. Lead walks and patios were digitized from photograph in each sample site. The percent impervious increase in these area ranged from 1.53% to 1.89%. Single family residential areas were determined using zoning classifications. The following zoning classification were considered residential for this analysis; R2-7, R-5, R-6, R-8, R-10T, R-10, and R-20. To account for the impervious area associated with lead walks and patios in residential areas 2% was added to the impervious surface in areas with single family zoning classifications.

The estimated 2009 impervious area in Arlington County was then computed. See Appendix A for the detailed explanation of the MS4 Service Area delineation methodology, which, combined with the 2009 impervious area computation, produced the 'Regulated Urban Impervious' and 'Regulated Urban Pervious' acres served by the MS4 shown in Table 2 (corresponds with Table 1 in Section I.D.1 of the permit). Table 3 provides the total 5% POC reduction required during the permit cycle (corresponds with Table 2 in Section I.D.1 of the permit).

[6] Note that in some cases impervious cover (and loads) increase and in some cases these variables decrease. All load changes from linear development projects (increases and decreases) will be accounted for in the County's Bay TMDL tracking and reporting.

This methodology was also used to compute impervious areas in drainage area computations associated with watershed retrofit and stream restoration projects.

Source	Pollutant	Total Existing Acres Served by MS4 (6/30/09)	2009 EOS Loading Rate (lbs/ac)	Estimated Total POC Load Based on 2009 Progress Run
Regulated Urban Impervious	Nitrogen	5,201.34	16.86	87,694.51
Regulated Urban Pervious		6,078.05	10.07	61,205.98
Regulated Urban Impervious	Phosphorus	5,201.34	1.62	8,426.16
Regulated Urban Pervious		6,078.05	0.41	2,492.00
Regulated Urban Impervious	Total Suspended Solids	5,201.34	1,171.32	6,092,427.71
Regulated Urban Pervious		6,078.05	175.8	1,068,521.54

Table 2. Estimated Existing Source Loads

Subsource	Pollutant	Total Existing Acres Served by MS4 (6/30/09)	2009 EOS Loading Rate (lbs/ac)	Estimated Total POC Load Based on 2009 Progress Run	Total
Regulated Urban Impervious	Nitrogen	5,201.34	0.08	416.11	
Regulated Urban Pervious		6,078.05	0.03	182.34	**598.45**
Regulated Urban Impervious	Phosphorus	5,201.34	0.01	52.01	
Regulated Urban Pervious		6,078.05	0.001	6.08	**58.09**
Regulated Urban Impervious	Total Suspended Solids	5,201.34	11.71	60,907.63	
Regulated Urban Pervious		6,078.05	0.77	4,680.10	**65,587.73**

Table 3. Total 5% POC Reduction Required During Permit Cycle

Table 3.A computes the total POC reductions for the end of the next permit cycle (40% cumulative requirement), based on the "seven times" the current permit cycle reductions for the draft 2nd phase TMDL Action Plan required by Section I.D.1.d.5.b of the permit. Table 3.A also computes, for planning purposes for the 3rd permit cycle, 100% of the POC reductions based on Virginia's adopted three permit cycle phased approach described in Appendix I of the Chesapeake Bay TMDL Special Condition Guidance, which states*: "The Commonwealth in its Phase I and Phase II Chesapeake Bay TMDL Watershed Implementation Plans (WIP) committed to a phased approach for MS4s, affording MS4 operators up to three full five-year permit cycles to implement necessary reductions."*

	TN	**TP**	**TSS**
40% cumulative POC reduction	4787.6	464.7	524701.9
100% cumulative POC reduction	11969.0	1161.8	1311754.7

Table 3.A. Cumulative 40% and 100% POC Reductions.

5. Means and Methods to Meet the Required Reductions and Schedule (f)

The County has an existing and comprehensive water quality improvement program. The means and methods implemented to date include watershed retrofit projects, stream restoration projects, redevelopment-based reductions, and 2006-2009 'historical BMPs.' The means and methods expected to be implemented moving forward include additional watershed retrofit projects, stream restoration projects, and redevelopment-based reductions, along with street sweeping program credits (anticipated when the expert panel completes its work).[7]

Table 4 provides a summary of the in-place reductions for each type/category of practice for this permit cycle. At this time, the 5% POC reduction requirement for this permit cycle has been met. Reduction progress beyond the 5% requirement is shown in Table 4 as creditable to the next permit cycle additional 35% POC reductions. These additional reductions will be included in the draft 2nd phase TMDL Action Plan required by Section I.D.1.d.5.b of the permit.

[7] Though in practice Arlington is not likely to utilize trading as a means or method of compliance during this permit cycle, this plan includes the option to transfer and apply credits from the County's wastewater treatment facility for any applicable POC.

	In place			
Project Type	**TN**	**TP**	**TSS**	**ACTUAL COST**
Watershed retrofits	56.7	6.5	5291.3	$ 892,112
Stream restoration	227.6	226.2	148046.2	$ 2,066,343
Redevelopment Jul 09 - June 14	146.8	8.2	7156.0	$ -
2006-2009 'Historical BMPs'	196.4	23.6	18738.6	$ -
Street sweeping	0.0	0.0	0.0	$ -
SUBTOTAL	**627.6**	**264.5**	**179232.1**	**$ 2,958,456**
Percent of first permit cycle POC load reduction	**104.9%**	**455.3%**	**273.3%**	
Credit toward first permit cycle POC load reduction	**598.4**	**58.1**	**65587.7**	
Credit toward second permit cycle POC load reduction	**29.1**	**206.4**	**113644.3**	
GRAND TOTAL	**627.6**	**264.5**	**179232.1**	**$ 2,958,456**
Percent of estimated total POC load reduction	**5.2%**	**22.8%**	**13.7%**	

Table 4. In-Place POC Reductions by Practice Type/Category

Table 5 provides a summary of the reductions for each type/category of practice for projects scheduled for completion during the remainder of this permit cycle. The actual combination, timing and extent of project type/category of practices may vary in the County's discretion from Table 5 and the supporting summaries below. Updates will be provided in each annual report as well as with the draft 2nd phase TMDL Action Plan. As shown in Table 5, POC reductions from these projects will be applied to the additional 35% POC reduction progress requirement for the next permit cycle (40% cumulative reduction) and, for TP, the additional POC reduction progress requirement for the third permit cycle (100% cumulative reduction).

	Scheduled			
	TN	TP	TSS	EST. COST
Watershed retrofits	1298.2	147.9	120612.9	$ 5,180,031
Stream restoration	119.9	124.6	81147.9	$ 1,787,737
Redevelopment Jul 14 - June 18	117.5	6.5	5724.8	$ -
Street sweeping	0.0	0.0	0.0	$ -
Scheduled credits	**1535.6**	**279.1**	**207485.6**	**$ 6,967,768**
In-place credits toward 2nd permit cycle POC load reduction	**29.1**	**206.4**	**113644.3**	
TOTAL	**1564.8**	**485.5**	**321129.9**	
Percent of second permit cycle POC load reduction	**33%**	**104%**	**61%**	
Credit toward third permit cycle POC load reduction	**0.0**	**58.1**	**0.0**	
GRAND TOTAL In-place + Scheduled credits	**2163.2**	**543.6**	**386717.7**	**$ 9,926,224**
Percent of estimated total POC load reduction	**18.1%**	**46.8%**	**29.5%**	

Table 5. Scheduled POC Reductions by Practice Type/Category

Project summaries are provided below.

For redevelopment, the 'in-place' reductions shown are for the July 1, 2009, through June 30, 2014 time period. As a placeholder, the 'Scheduled' reductions shown for the redevelopment category are placeholders based on pro-rated estimates for the four year FY15 through FY18 period (through year 5 of the permit cycle) using the same reduction rate achieved in the FY09 through FY14 period. These placeholder values are not guaranteed; actual reductions from FY 2015 and beyond will be reported with the FY 2015 annual report and subsequent reports.

Watershed Retrofits

Appendix C provides the drainage area, pollutant removal, and cost details for each of the watershed retrofit projects summarized in Tables 4 and 5. The County used the 'retrofit adjustor curve' method outlined in the Urban Stormwater Retrofits Expert Panel Report and the DEQ TMDL Action Plan guidance methodology to compute pollutant removal efficiencies and POC reductions from each project.

These projects consist of three main categories:

- *Green streets*

A 'green street' includes a vegetated system in the public right-of-way that reduces stormwater volume and pollution. Projects include rain garden/bioretention, dry swales and stormwater planter systems. For more information see http://projects.arlingtonva.us/programs/stormwater-management/green-streets/ .

The County's adopted Stormwater Master Plan includes a list of 159 high priority watershed retrofit projects that consist mostly of green streets projects. See http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2014/05/Appendix_C_HPP.pdf

- *Municipal facilities*

Arlington began retrofitting its Trades Center facility in 2011 with two types of proprietary systems – Stormfilters and Ultra-Urban Filters (catch basin insert system).

For the Stormfilter system, the County applied the methodology described in 3.B to compute removal efficiencies for TN and TSS, as follows:

- Computed the runoff depth (0.6") that produces the 45% TP removal efficiency for the Stormfilter in the clearinghouse.
- Used this depth with the TN and TSS ST Retrofit Adjustor Curves to determine the TN and TSS removal efficiencies—29% and 58%, respectively.

For the Ultra Urban Filters, which are not in the Clearinghouse but which remove significant amounts of sediment, the County:

- Applied the lowest TP removal for Bay program BMPs (10%) and computed the runoff depth associated with this removal rate (0.09 inches).
- Used this depth with the TN and TSS ST Retrofit Adjustor Curves to determine the TN and TSS removal efficiencies—7% and 13%, respectively.

- *Larger-scale facilities*

These opportunities are limited in a dense urban area like Arlington. However, one large-scale retrofit will be implemented during this permit cycle with the Ballston Pond constructed wetland project. The County used the ST retrofit adjustor curves, along with the storage volume of the pond (per the Urban Retrofit Expert Panel report), to compute the 'inches treated' and pollutant removal efficiencies. The POC loads to the BMP and load reductions were then determined, in accordance with the DEQ Chesapeake Bay TMDL Special Condition Guidance. See Appendix D for computations.

Stream Restoration Projects

See Appendix D for detailed computations using the DEQ Chesapeake Bay TMDL Special Condition Guidance methodology and Appendix E for basin maps for each project. For the four projects below, the County applied the 'interim revised' POC reduction credits because the stream assessment and design process pre-dates the Chesapeake Bay Expert Panel methods. The first two projects are currently scheduled for completion during the permit cycle (the estimated POC reduction credits are included in Table 5). The second two projects are 'historical' projects in-place and completed in 2006-2007 (included in Table 4). Appendix F includes summary photos documenting existing degraded conditions and, for the completed projects, post-construction conditions.

- *Windy Run*

This stream restoration project is 525 linear feet and will help address severe stream erosion threatening trees and sanitary sewer infrastructure along the stream as well as causing trail and slope damage. "Natural channel design" principles will be used to create a new stream channel in balance with the runoff it receives from the watershed. The stream will be reconnected with a floodplain area. During higher flows, the stream can flow onto the floodplain and the water will slow down and reduce its energy. In addition, step pool structures will be added with rocks to help reduce the energy of the flow. Extensive native vegetation plantings and invasive plant control will also be project elements. Several eroding and damaged stormwater outfalls will also be repaired, and an exposed/elevated sanitary sewer line will be re-routed to cross the stream under the new channel invert. For more information see: http://projects.arlingtonva.us/projects/windy-run-stream-restoration/

- *Donaldson Run Tributary B*

The stream restoration project is 1,355 linear feet and will also be restored using natural channel design principles to address severe erosion from stormwater runoff. Floodplain reconnection, step pool grade controls, native plantings and invasive plant controls, and stormwater outfall repairs are key project elements. For more information see: http://projects.arlingtonva.us/projects/donaldson-run-stream-restoration-tributary-b/

- *Donaldson Run Tributary A*

This stream restoration project is a 'historical' project completed in 2006 with repair work from a 100-year storm completed in 2007. The project consists of 2,890 linear feet restored using natural channel design principles to address severe erosion from stormwater runoff. Floodplain reconnection, step pool grade controls, native plantings and invasive plant controls, and stormwater outfall and sanitary sewer repair and protection were all key project elements.

- *Donaldson Run Headwaters*

This stream restoration project is a 'historical' project completed in 2007 and consists of 480 linear feet restored using natural channel design principles to address severe erosion from stormwater runoff. Floodplain reconnection, step pool grade controls, native plantings and invasive plant controls, and sanitary sewer repair and protection were all key project elements.

- *'Historical BMPs' from 2006 to 2009*

The County selected public and private stormwater quality management facilities constructed between 1/1/2006 and 6/30/2009 with recorded maintenance agreements and ongoing maintenance tracking. The methodology in 3.A above was then used to determine the load reductions from these facilities, with the exception that the load changes from land uses changes associated with these BMPs were not accounted for because these land use conditions and loads are already reflected in the 2009 land use baseline.

See Appendix B for summary information for computations for loads removed for 'Historical BMPs.'

<u>Potential Reductions</u>

The following projects are included in this Plan as 'potential' reductions as explained in each description below. Implementation and use of any particular project for compliance with the POC reduction progress requirement applicable for this permit cycle or future cycles will be determined subsequently. In that case, the project and additional analysis and computations that are performed will be documented in future annual reports.

- *Four Mile Run Tidal Restoration Project*

This project consists of rip-rap and invasive plant removal, living shoreline creation, and streambank bioengineering along 4,200 linear feet of the tidal portion of the Four Mile Run flood control project.

There will be nine living shoreline features created totaling approximately 1,428 linear feet and 0.57 acres of planted tidal wetland. Based on the current draft Shoreline Management expert panel methodology, Protocols 2, 3, and 4 appear to be applicable and could provide the following approximate POC reduction credits: TN = 50 lbs.; TP = 3 lbs.; TSS = 4,000 lbs.

For more information see: http://projects.arlingtonva.us/projects/four-mile-run-stream-restoration/.

- *Sparrow Pond BMP restoration*

This constructed wetland was completed in 2002, and receives runoff from approximately 80 acres of land. Significant erosion is occurring along the privately-owned stream channel that flows into the wetland, resulting in a large amount of sediment deposition in the facility.

This project appears to be a candidate for incremental BMP restoration credit per the Expert Panel Urban Stormwater Retrofits report and DEQ guidance.

An existing conditions survey is planned to document and compare the facility's current volume to the design volume and then to compute the incremental POC reduction credits that could result from restoring the design volume (and maintaining it over time). Planning-level estimates indicate these credits could be significant: TN = 100 lbs.; TP = 10 lbs; TSS = 10,000 lbs.

6. Means and Methods to Offset the Increase load from New Sources initiating Construction between July 1, 2009 and June 30, 2014 (g)

Accounted for with Item 3 above. Net POC reduction occurred during this time period from all regulated land disturbing activity. No offsets required for TMDL accounting purposes.

7. Means and Methods to be Utilized to Offset the Increase Load from Grandfathered /Projects that Begin Construction after July 1, 2014 (h)

Per the DEQ Chesapeake Bay TMDL Special Condition Guidance, this requirement pertains to grandfathered projects that disturb one acre or greater that began construction after July 1, 2014, where the project utilizes an average land cover condition greater than 16% impervious cover in the design of post-development stormwater management facilities.

All grandfathered projects will be required to meet the County's Chesapeake Bay Preservation Ordinance requirements in effect prior to July 1, 2014. This ordinance used a 16% average land cover condition, although a partial fee-in-lieu program existed prior to 2011. However, load changes (increases or decreases) associated with grandfathered projects will be computed using the same methodology described under Item 3 and therefore accounted for completely.

It is expected that any offset loads that may be computed for specific grandfathered projects will be significantly less than the POC reductions that will result from redevelopment projects during the permit cycle (as occurred in the 2009-2014 accounting period). Therefore, no separate grandfathered project offsetting will likely be required. This will be documented in the accounting described in Item 3.

8. A list of future projects, and associated acreage that qualify as grandfathered (i)

The new development projects on record that qualify as grandfathered are listed below. As noted in Item 7, load changes will be computed as described under Item 3.

Name	Address	Site Plan	Site Area (Acres)
Potomac Yard - Land Bay C	Jefferson Davis Hwy	346	4.36
Potomac Yard - Land Bay D-West	Jefferson Davis Hwy	346	1.44

9. An estimate of the expected cost to implement the necessary reductions (j)

See Tables 4 and 5 in Item 5 above.

10. Public Comments on Draft Action Plan

(b. PHASE I PERMIT REQUIREMENTS) (k) and (l)

Arlington County has received public comment on the County's Bay TMDL Action Plan in several ways. The County Board adopted an updated Stormwater Master Plan in September 2014 through a comprehensive civic engagement process. The Master Plan outlined and described the County's overall strategy to meet the Chesapeake Bay TMDL requirements, which includes a combination of stream restoration, watershed retrofits, trading, and street sweeping.

The County conducted an extensive public process for the Stormwater Master Plan, with multiple public meetings, public hearings, newspaper and web advertisements, and press releases. Public comments were received on the plan and revisions to the plan were made to address the comments. The summary of public comments received on the Stormwater Master Plan is available online.

In addition, the County made the draft Bay TMDL Action Plan available for comment on the web during May 2015 and advertised the plan through a public announcement in a local newspaper. The County also publicized the plan via announcements on the web and distribution through email listservs to residents, and presented an overview of the plan to the County's Environment and Energy Conservation Commission at a public meeting. The summary of comments received and the County's response (including any changes to the action plan document) is included as Appendix G.

Appendices

- **A.** ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION
- **B.** 2009-2014 BMP ACCOUNTING AND 2006-2009 HISTORICAL BMP ACCOUNTING
- **C.** WATERSHED RETROFIT COMPUTATIONS
- **D.** STREAM RESTORATION AND LARGE SCALE PROJECTS COMPUTATIONS
- **E.** STREAM RESTORATION AND LARGE SCALE PROJECTS BASIN MAPS
- **F.** STREAM RESTORATION PROJECTS DOCUMENTATION
- **G.** SUMMARY OF PUBLIC COMMENT/RESPONSE

APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

Arlington County has estimated its MS4 Service area in accordance with its MS4 permit and the DEQ Chesapeake Bay TMDL Special Condition Guidance as set forth below.

Arlington's detailed methodology uses the County Boundary in the Geographic Information System (GIS) and subtracts the area associated with following facilities and lands:

1. Other Permitted Facilities (including VDOT)
2. Other State and Federal owned land (not permitted)
3. Forests and direct drainage into streams

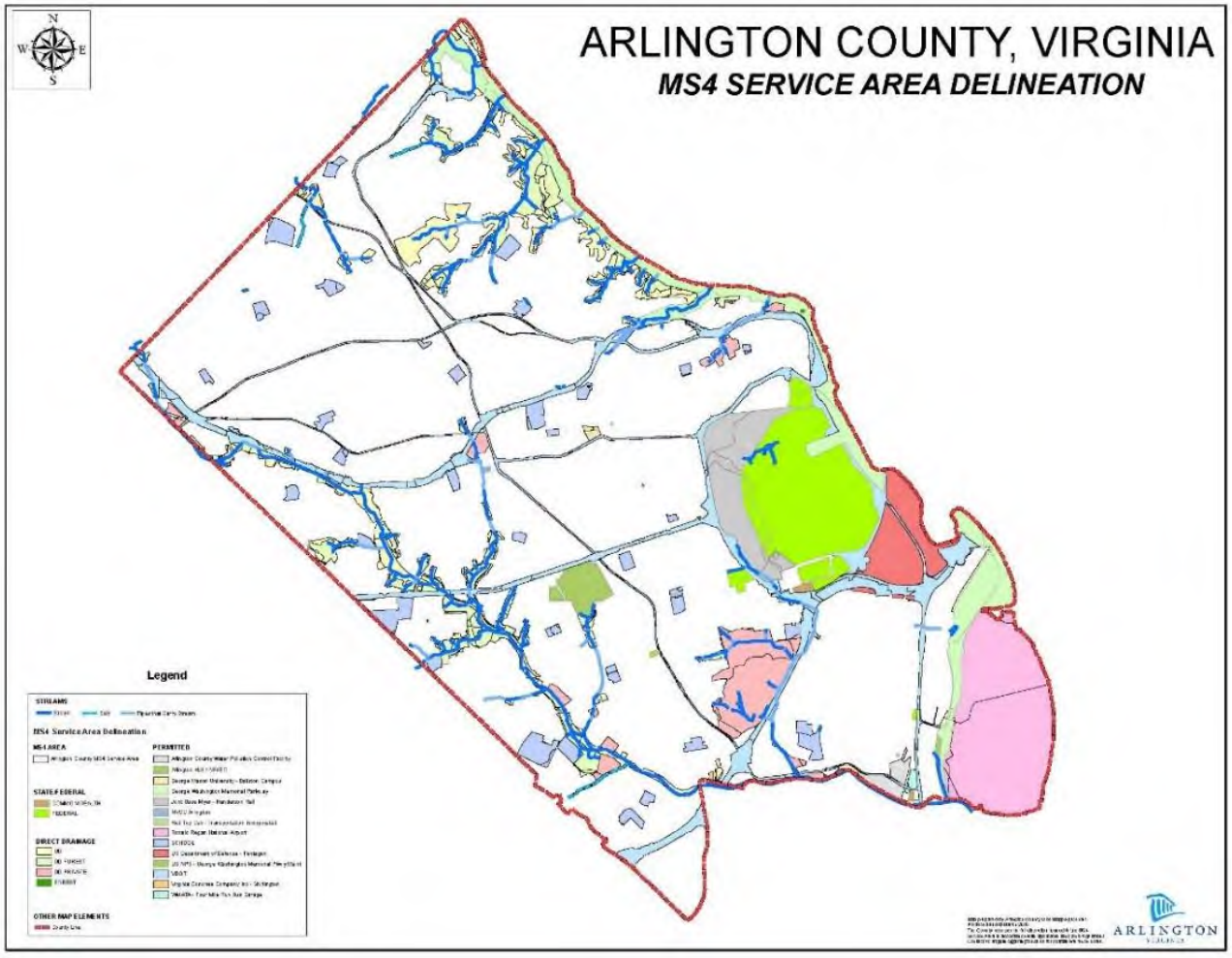
At this time, Arlington has opted to use a conservative approach (i.e., over-estimation) in that land that drains to MS4 systems in category 1 above (Other Permitted Facilities) from beyond category 1 property or right-of-way boundaries is NOT subtracted from Arlington's MS4 service area. Arlington is currently using this conservative approach due to several factors, including complex downstream interconnections to Arlington's MS4 in many cases, lack of regulatory oversight for such lands by these other MS4 systems, and mapping limitations. Arlington may opt to refine this aspect of its methodology in the future to eliminate over-estimation. In the interim, this approach leads to a higher calculated service area and thus greater pollutant reductions than a more precise approach.

Summary table, lands subtracted from MS4 service area:

Category	Total Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)
Arlington County Area	**16,690.44**	**7,050.31**	**9,639.50**
Permitted	**3,302.21**	**1,573.85**	**1,728.33**
State/Federal	**720.51**	**126.11**	**594.40**
Direct Drainage	**1,388.33**	**149.01**	**1,238.72**
MS4 Service Area	**11,279.39**	**5,201.34**	**6,078.05**

APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

Graphical representation of MS4 service area:



APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

1. Permitted Facilities –
    a. Parcels were identified in the tax records and the entire parcel area was subtracted from the service area, regardless of drainage patterns.

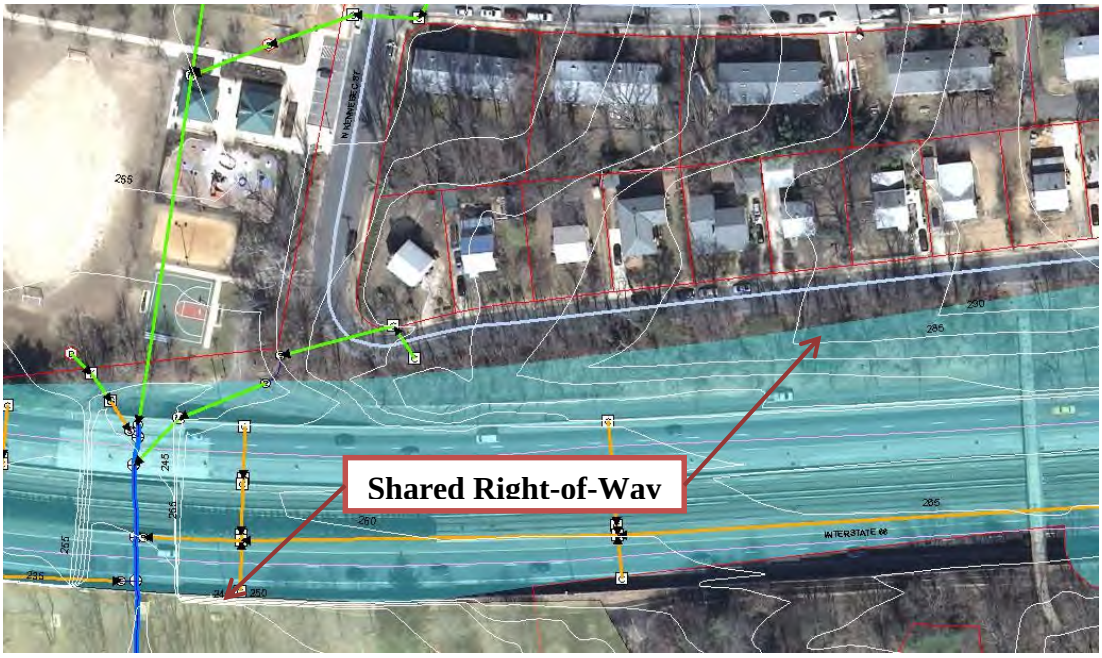
Facility	Site Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)
Arlington County Water Pollution Control Facility	41.29	18.95	22.34
Arlington Hall / NFATC	84.94	29.89	55.05
George Mason University - Ballston Campus	7.59	4.64	2.95
George Washington Memorial Parkway	626.56	95.53	531.02
Joint Base Myer - Henderson Hall	280.79	132.31	148.48
NVCC Arlington	1.89	1.61	0.28
Red Top Cab - Transportation Incorporated	0.32	0.27	0.05
Ronald Reagan National Airport	723.07	440.06	283.01
US Department of Defense - Pentagon	232.74	157.12	75.62
US NPS - George Washington Memorial Pkwy Maint	4.78	3.19	1.59
Virginia Concrete Company Inc - Shirlington	3.05	1.81	1.23
WMATA - Four Mile Run Bus Garage	7	6.7	0.29
Arlington County Schools	358.33	140.93	217.4
VDOT	929.86	540.84	389.02
Total	**3,302.21**	**1,573.85**	**1,728.33**

    b. Virginia Department of Transportation - In most cases VDOT areas are defined as the area within the right-of-way, except in areas were the right-of way includes both VDOT and Arlington County roadways and VDOT and Federal roadways. In the case of shared right-of-way, VDOT's portions were determined with heads-up digitizing using the 2011 topography to determine the area draining into VDOT network.

Site Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)
929.86	**540.84**	**389.02**

APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

Examples of each type of VDOT areas:



2. Other State and Federal owned land (not permitted)

   Parcels were identified in the tax records and the entire parcel area was subtracted from the service area, regardless of drainage patterns for the following ownership:

Facility	Site Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)
Commonwealth	10.33	6.85	3.48
Federal*	710.18	119.26	590.92
Total	**720.51**	**126.11**	**594.40**

*Includes Arlington National Cemetery

3. Direct drainage into streams

   Direct drainage into streams was determined with heads-up digitizing using the 2011 topography to determine the areas. Direct drainage is broken into three categories:

   a. Direct drainage Forest Streams – forested area that drains directly into streams[1].
   b. Direct Drainage Streams– non-forested area that drains directly into streams and does not drain into any portion of Arlington County's MS4 system.
   c. Direct Drainage Private Streams – Areas that have privately owned storm sewer systems that drain directly into a stream and does not drain into any portion of Arlington County's MS4 system.

Facility	Site Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)
Forest	.6	0	0
DD Forest Streams	478.39	6.31	472.08
DD Streams	549.61	71.69	477.92
DD Private Streams	359.73	71.01	288.72
Total	**1,388.33**	**149.01**	**1238.72**

[1] Although DEQ guidance states that any forest land, including forest land that drains to the MS4, can be excluded from the MS4 service area, this situation does not exist in Arlington. Arlington's forest lands are in stream valleys with direct drainage to the stream. There is a very small portion (<1 acre) of forest land that drains to the GW Parkway (a permitted property), and this small forest area is included in the numbers above for simplicity.

APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

Examples of each type of direct drainage:

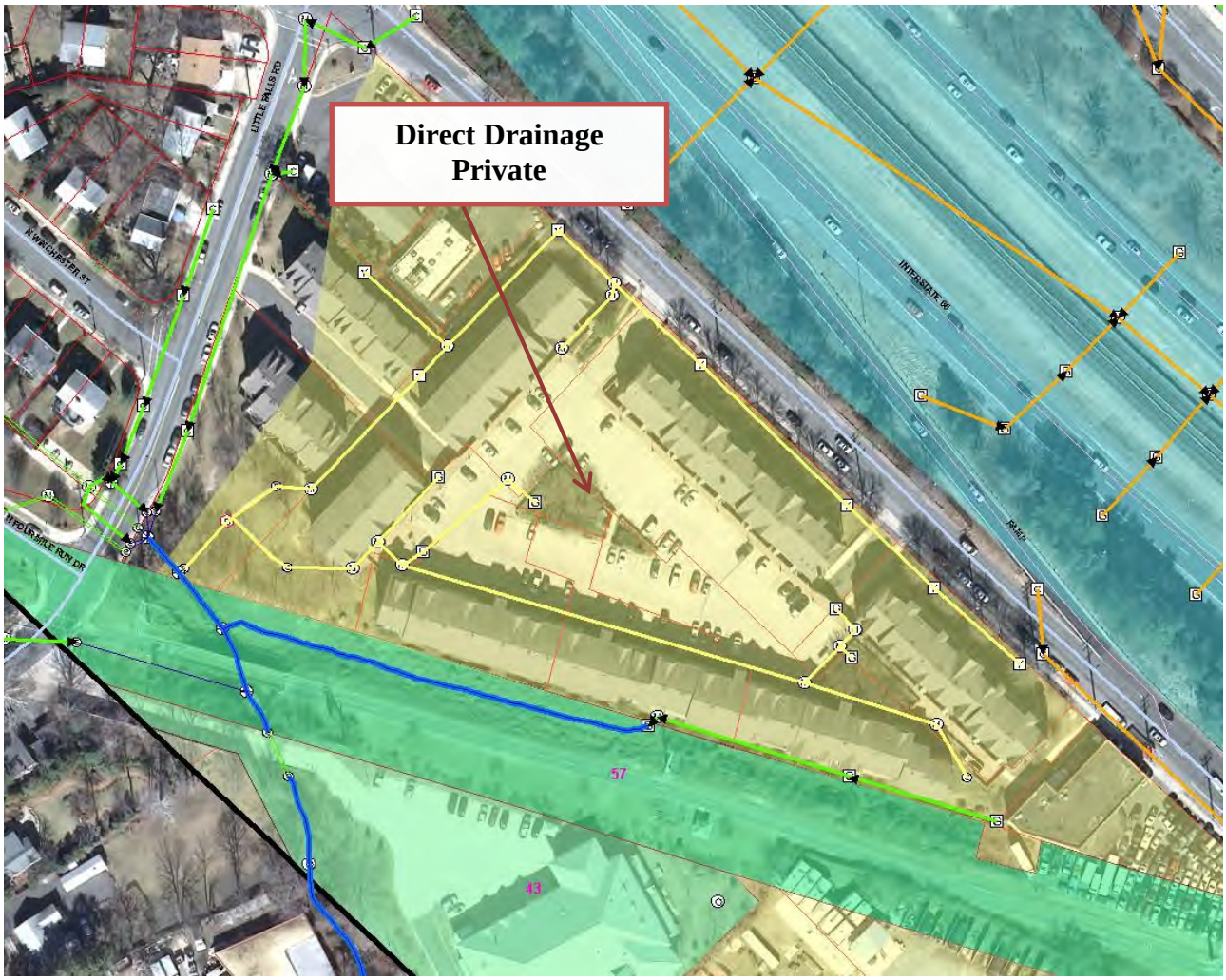
Direct drainage Forest Streams – forested areas that drain directly into streams. Example shown below:

APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

Direct Drainage Streams – non-forested area that drains directly into streams and does not drain into any portion of Arlington County's MS4 system.

APPENDIX A
ARLINGTON COUNTY MS4 SERVICE AREA DELINEATION METHODOLOGY

Direct Drainage Private Streams – Areas that have privately owned storm sewer systems that drain directly into a stream and does not drain into any portion of Arlington County's MS4 system.



Appendix B
2009-2014 BMP ACCOUNTING AND 2006-2009 HISTORICAL BMP ACCOUNTING
ADJUSTOR CURVE METHOD WITH MS4 PERMIT LOADING RATES

Summary of BMP's 2009-2014

RR practices

			IMPERVIOUS	LOADS (per DCR Potomac River Basin)			PERVIOUS	LOADS (per DCR Potomac River Basin)			TOTAL LOADS to SWMF				REMOVAL RATES per adjustor curves			Total Loads removed		
SWMF Type	Drain To MS4	Total drainage area (ac)	Area (ac)	TP	TN	TSS	Area (ac)	TP	TN	TSS	TP	TN	TSS	Runoff depth treated (in)	TP	TN	TSS	TP	TN	TSS
Bioretention 1	Yes	10.8986	6.9237	**11.2**	**116.7**	**8109.9**	3.8441	**1.6**	**38.7**	**675.8**	12.8	155.4	8785.7	0.50	**52%**	**45%**	**56%**	**6.7**	**69.7**	**4920.0**
Bioretention 1	No	0.5657	0.2757	**0.4**	**4.6**	**322.9**	0.29	**0.1**	**2.9**	**51.0**	0.6	7.6	373.9	0.50	**52%**	**45%**	**56%**	**0.3**	**3.4**	**209.4**
Bioretention 2	Yes	2.95	1.95	**3.2**	**32.9**	**2284.1**	1	**0.4**	**10.1**	**175.8**	3.6	42.9	2459.9	1.00	**70%**	**60%**	**75%**	**2.5**	**25.7**	**1842.7**
Bioretention 2	No	0.14	0.14	**0.2**	**2.4**	**164.0**	0	**0.0**	**0.0**	**0.0**	0.2	2.4	164.0	1.00	**70%**	**60%**	**75%**	**0.2**	**1.4**	**122.8**
GreenRoof	Yes	0.2058	0.21	**0.3**	**3.5**	**241.1**	0	**0.0**	**0.0**	**0.0**	0.3	3.5	241.1	0.50	**52%**	**45%**	**56%**	**0.2**	**1.6**	**135.0**
Infiltration Trench	No	5.02	1.74	**2.8**	**29.3**	**2038.1**	3.27	**1.3**	**32.9**	**574.9**	4.2	62.3	2613.0	0.50	**52%**	**45%**	**56%**	**2.2**	**27.9**	**1463.3**
Pavers	Yes	4.8785	4.88	**7.3**	**75.5**	**5247.5**	0	**0.0**	**0.6**	**9.8**	7.3	76.1	5257.4	0.50	**52%**	**45%**	**56%**	**3.8**	**34.1**	**2944.2**
Pavers	No	0.26	0.26	**0.4**	**4.4**	**304.5**	0	**0.0**	**0.0**	**0.0**	0.4	4.4	304.5	0.50	**52%**	**45%**	**56%**	**0.2**	**2.0**	**170.5**
Total																		**16.2**	**167.7**	**11979.0**

ST practices

			IMPERVIOUS	LOADS (per DCR Potomac River Basin)			PERVIOUS	LOADS (per DCR Potomac River Basin)			TOTAL LOADS to SWMF				REMOVAL RATES per adjustor curves			Total Loads removed		
SWMF Type	Drain To MS4	Total drainage area (ac)	Area (ac)	TP	TN	TSS	Area (ac)	TP	TN	TSS	TP	TN	TSS	Runoff depth treated (in)	TP	TN	TSS	TP	TN	TSS
Manufactured-Filtering	Yes	28.1	25.5	**41.3**	**429.9**	**29868.7**	2.5	**1.0**	**25.6**	**446.5**	42.4	455.5	30315.2	0.50	**41%**	**26%**	**52%**	**17.4**	**119.0**	**15844.8**
Manufactured-Hydrodynamic	Yes	3.6	3.6	**5.8**	**60.9**	**4228.5**	0	**1.0**	**25.6**	**446.5**	6.9	86.4	4675.0	0.19	**20%**	**13%**	**26%**	**1.2**	**7.9**	**1101.2**
																	Total	**20.1**	**137.1**	**18333.8**

Grand Total	**36.3**	**304.8**	**30312.8**

Appendix B
2009-2014 BMP ACCOUNTING AND 2006-2009 HISTORICAL BMP ACCOUNTING
ADJUSTOR CURVE METHOD WITH MS4 PERMIT LOADING RATES

Summary of Historical BMP's 2006-2009

RR practices																				
			IMPERVIOUS	LOADS (per DCR Potomac River Basin)			PERVIOUS	LOADS (per DCR Potomac River Basin)			TOTAL LOADS to SWMF				REMOVAL RATES per adjustor curves			Total Loads removed		
SWMF Type	Drain To MS4	Total drainage area (ac)	Area (ac)	TP	TN	TSS	Area (ac)	TP	TN	TSS	TP	TN	TSS	Runoff depth treated (in)	TP	TN	TSS	TP	TN	TSS
Dry Swale	Yes	1.405	0.64	**1.0**	**10.8**	**749.6**	0.765	**0.3**	**7.7**	**134.5**	1.4	18.5	884.1	0.17	**23%**	**20%**	**25%**	**1.8**	**26.7**	**0.3**
Bioretention 1	Yes	1.08	0.7398	**1.2**	**12.5**	**866.5**	0.3402	**0.1**	**3.4**	**59.8**	1.3	15.9	926.3	0.50	**52%**	**45%**	**56%**	**0.7**	**7.1**	**518.8**
Bioretention 2	Yes	0.0161	0.0161	**0.0**	**0.3**	**18.9**	0	**0.0**	**0.0**	**0.0**	0.0	0.3	18.9	1.00	**70%**	**60%**	**75%**	**0.0**	**0.2**	**14.1**
GreenRoof	Yes	0.0042	0.0042	**0.0**	**0.1**	**4.9**	0	**0.0**	**0.0**	**0.0**	0.0	0.1	4.9	0.50	**52%**	**45%**	**56%**	**0.0**	**0.0**	**2.8**
Infiltration Trench	Yes	2.6637	2.0995	**3.4**	**35.4**	**2459.2**	0.5642	**0.2**	**5.7**	**99.2**	3.6	41.1	2558.4	0.50	**52%**	**45%**	**56%**	**1.9**	**18.4**	**1432.7**
Pavers	Yes	0.1595	0.1595	**7.3**	**75.5**	**5247.5**	0	**0.0**	**0.6**	**9.8**	7.3	76.1	5257.4	0.50	**52%**	**45%**	**56%**	**3.8**	**34.1**	**2944.2**
Total																		**8.2**	**86.6**	**4912.8**
ST practices			IMPERVIOUS	LOADS (per DCR Potomac River Basin)			PERVIOUS	LOADS (per DCR Potomac River Basin)			TOTAL LOADS to SWMF				REMOVAL RATES per adjustor curves			Total Loads removed		
SWMF Type	Drain To MS4	Total drainage area (ac)	Area (ac)	TP	TN	TSS	Area (ac)	TP	TN	TSS	TP	TN	TSS	Runoff depth treated (in)	TP	TN	TSS	TP	TN	TSS
Manufactured-Filtering	Yes	23.6	19.2	**31.2**	**324.2**	**22524.1**	4.4	**1.8**	**44.2**	**771.6**	33.0	368.4	23295.7	0.50	**41%**	**26%**	**52%**	**13.5**	**96.3**	**12175.9**
Manufactured-Hydrodynamic	Yes	6.9	5.2	**8.3**	**86.8**	**6032.3**	1.7	**0.7**	**17.3**	**302.4**	9.0	104.1	6334.7	0.19	**20%**	**13%**	**26%**	**1.9**	**13.6**	**1649.8**
																	total	**15.4**	**109.8**	**13825.7**
																	Grand Total	**23.6**	**196.4**	**18738.6**

Appendix C
WATERSHED RETROFIT COMPUTATIONS
ADJUSTOR CURVE METHOD WITH MS4 PERMIT LOADING RATES

ID	Name	Status	FY (Actual and Estimated)	Cost	Total Drainage Area(ac)	Impervious Area (ac)	Pervious Area (ac)	TP	TN	TSS
03-887H	4300 29TH S Earth Product Recycling - Stormfilter	Completed	2011	$163,291.00	2.00	2.00	0.00	1.46	9.70	1347.93
2011-0A	2701 S Taylor St-Manufactured - Ultra Urban Inserts (6)	Completed	2011		0.38	0.38	0.00	0.06	0.42	58.56
2011-0B	2701 S Taylor St-Manufactured - Ultra Urban Inserts (6)	Completed	2011		0.08	0.08	0.00	0.01	0.09	12.33
2011-0C	2701 S Taylor St-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.10	0.10	0.00	0.02	0.11	15.41
2011-0D	2701 S Taylor St-Manufactured - Ultra Urban Inserts (12)	Completed	2011		0.81	0.81	0.00	0.14	0.90	124.82
2011-0E	2701 S Taylor St-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.31	0.31	0.00	0.05	0.34	47.77
2011-0F	2701 S Taylor St-Manufactured - Ultra Urban Inserts (6)	Completed	2011		0.13	0.13	0.00	0.02	0.14	20.03
2011-0G	2701 S Taylor St-Manufactured - Ultra Urban Inserts (6)	Completed	2011		1.69	1.69	0.00	0.28	1.87	260.43
2011-0H	2701 S Taylor St-Manufactured - Ultra Urban Inserts (12)	Completed	2011		0.64	0.64	0.00	0.11	0.71	98.62
2011-0I	2701 S Taylor St-Manufactured - Ultra Urban Inserts (12)	Completed	2011	$75,700.00	0.16	0.16	0.00	0.03	0.18	24.66
2011-0J	4200 28Th St S-Manufactured - Ultra Urban Inserts (6)	Completed	2011		0.32	0.32	0.00	0.05	0.35	49.31
2011-0K	4200 28Th St S-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.17	0.17	0.00	0.03	0.19	26.20
2011-0L	4200 28Th St S-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.01	0.01	0.00	0.00	0.01	1.54
2011-0M	4200 28Th St S-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.03	0.03	0.00	0.01	0.03	4.62
2011-0N	4200 28Th St S-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.05	0.05	0.00	0.01	0.06	7.70
2011-0O	2881 S Taylor St-Manufactured - Ultra Urban Inserts (1)	Completed	2011		0.25	0.25	0.00	0.04	0.28	38.52
2011-0P	4250 29Th St S-Manufactured - Ultra Urban Inserts (6)	Completed	2011		0.19	0.19	0.00	0.03	0.21	29.28
2011-0Q	2701 S Taylor St-Manufactured - Ultra Urban Inserts (6) - Model Co1414H	Completed	2011		0.10	0.10	0.00	0.02	0.11	15.41
2011-1A	PH Drive & 9th Rd N - South	Completed	2011		0.57	0.40	0.17	0.53	5.37	396.87
2011-1B	PH Drive & 9th Rd N - North	Completed	2011	$ 55,937.80	0.18	0.11	0.07	0.15	1.64	113.28
2012-2	Albemarle Bioretention	Completed	2012		0.73	0.27	0.46	0.47	5.90	319.65
2012-3	Weenie Beenie Bioswale	Completed	2012	$ 48,554.00	0.08	0.08	0.00	0.08	0.72	62.96
2014-4A	Gulf Branch Nature Center - Stormwater Planters	Completed	2014	$ 40,303.00	0.01	0.01	0.00	0.02	0.17	14.84
					0.01	0.01	0.00	0.01	0.08	6.75
2014-4B	Gulf Branch Nature Center - Infiltration Trench/Pervious Pavement	Completed	2014		0.17	0.16	0.01	0.20	1.85	155.18
2014-5A	Pentagon City Median - North	Completed	2014	$ -	1.21	0.96	0.25	1.04	10.07	787.78
2014-5B	Pentagon City Median - South	Completed	2014	$ -	0.72	0.57	0.15	0.75	7.26	568.09

Appendix C
WATERSHED RETROFIT COMPUTATIONS
ADJUSTOR CURVE METHOD WITH MS4 PERMIT LOADING RATES

ID	Name	Status	FY (Actual and Estimated)	Cost	Total Drainage Area(ac)	Impervious Area (ac)	Pervious Area (ac)	TP	TN	TSS
2014-5C	Pentagon City - Stormwater Planters A-E	Completed	2014	$ -	0.58	0.57	0.01	0.38	3.40	292.57
2014-5D	Pentagon City - Stormwater Planters F-K	Completed	2014	$ -	0.54	0.52	0.02	0.51	4.64	396.97
2015-6	8th St S Curbside	Pending as-built	2015	$ 43,691.06	0.00	0.00	0.00	0.00	0.00	0.00
0	11th St Park	Design	2016	$ 70,299.00	0.89	0.11	0.78	1.00	11.94	670.07
0	PH Drive & 20th St N	Design	2016	$154,929.36	3.04	1.18	1.86	0.63	8.57	382.05
0	John Marshall Drive - A	Design	2016		1.77	0.92	0.85	1.04	12.43	783.98
0	John Marshall Drive - B	Design	2016	$250,000.00	0.68	0.19	0.49	3.60	33.94	2986.33
0	Kensington St - A (32nd St)	Design	2016		2.07	0.77	1.30	0.54	7.58	246.69
0	Kensington St - B	Design	2016	$213,750.00	1.92	0.63	1.29	0.89	11.23	474.21
0	N. Sycamore Street	Design	2016	$279,237.98	4.87	2.73	2.14	0.88	13.37	363.18
0	Northside Leaf/Mulch Storage Facility	Design	2016	$ 86,637.25	0.73	0.73	0.00	0.00	0.00	0.00
0	Williamsburg Medians 1 - North	Design	2016	$339,283.95	0.55	0.44	0.11	0.16	1.81	204.04
0	Williamsburg Medians 1 - South	Design	2016	$ -	1.18	0.59	0.59	1.49	15.25	1264.48
0	Walter Reed Decal Project - 5th St S	Design	2017	$149,120.00	0.84	0.51	0.33	0.64	6.65	447.59
0	Walter Reed Decal Project - 9th St S	Design	2017	$ 55,000.00	0.73	0.57	0.16	0.54	5.25	423.78
0	Williamsburg Medians 2 - A-C	Design	2017		0.93	0.63	0.30	1.00	9.80	812.19
0	Williamsburg Medians 2 - D	Design	2017	$282,023.54	0.80	0.57	0.23	0.19	2.28	159.00

For more detailed information on calculations see RetrofitTracking spreadsheet.

Appendix D
STREAM RESTORATION AND LARGE SCALE PROJECTS COMPUTATIONS
URBAN STREAM RESTORATION INTERIM REMOVAL RATES AND
ADJUSTOR CURVE METHOD WITH MS4 PERMIT LOADING RATES

Urban Stream Restoration

Step 1:

Calculate the POC Reduction from the Proposed Stream Restoration Project:

Table V.H.1 - Urban Stream Restoration Interim Approved Removal Rates

BMP	How Credited	TN	TP	TSS
Stream Restoration	mass reduction/length(lbs/linear ft)	0.075	0.068	44.88
Windy Run	525	39.375	35.7	23562

Step 2:

Characterize the Acres Draining to the Proposed Stream Restoration Project:

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated AC	102.53	146.54	249.07		
Regulated APS	3.15	5.92	9.07		
Regulated VDOT	3.57	0.77	4.33		
Regulated FED			0.00		
Unregulated Land	1.66	5.94	7.60	10.58	Total
		Total	270.07	10.58	280.65

Ratios of regulated, unregulated and forested acres to total acres

Regulated AC	0.89
Regulated APS	0.03
Regulated VDOT	0.02
Regulated FED	0.00
Unregulated Land	0.03
Forest Land	0.04

Step 3:

Calculate the Total Reduction for Regulated and Unregulated Urban Lands

Available credit is calculated by multiplying possible credit by the ratio calculated in step 2

		Possible Credit	Ratio	Available Credit
Regulated AC	TN	39.38	0.89	34.94
	TP	35.70	0.89	31.68
	TSS	23562.00	0.89	20910.42
Regulated APS	TN	39.38	0.03	1.27
	TP	35.70	0.03	1.15
	TSS	23562.00	0.03	761.46
Regulated VDOT	TN	39.38	0.02	0.61
	TP	35.70	0.02	0.55
	TSS	23562.00	0.02	363.84
Regulated FED	TN	39.38	0.00	0.00
	TP	35.70	0.00	0.00
	TSS	23562.00	0.00	0.00
Unregulated Land	TN	39.38	0.03	1.07
	TP	35.70	0.03	0.97
	TSS	23562.00	0.03	638.05
Forest Land	TN	39.38	0.04	1.48
	TP	35.70	0.04	1.35
	TSS	23562.00	0.04	888.23

Step 4:

Account for the Total Baseline Reduction on Unregulated land and Other Regulated land

UNREGULATED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Unregulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	1.66	2.66	6.22
Unregulated Urban Pervious		0.03	0.6	5.94	3.56	
Unregulated Urban Impervious	TP	0.01	0.2	1.66	0.33	0.45
Unregulated Urban Pervious		0.001	0.02	5.94	0.12	
Unregulated Urban Impervious	TSS	11.71	234.2	1.66	388.77	480.25
Unregulated Urban Pervious		0.77	15.4	5.94	91.48	

Regulated APS	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction	TOTALS
Unregulated Urban Impervious	TN	0.08	1.6	3.15	5.04	8.59	14.76
Unregulated Urban Pervious		0.03	0.6	5.92	3.55		
Unregulated Urban Impervious	TP	0.01	0.2	3.15	0.63	0.75	1.48
Unregulated Urban Pervious		0.001	0.02	5.92	0.12		
Unregulated Urban Impervious	TSS	11.71	234.2	3.15	737.66	828.83	1676.27
Unregulated Urban Pervious		0.77	15.4	5.92	91.17		

Regulated VDOT	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	3.57	5.71	6.17
Unregulated Urban Pervious		0.03	0.6	0.77	0.46	
Unregulated Urban Impervious	TP	0.01	0.2	3.57	0.71	0.73
Unregulated Urban Pervious		0.001	0.02	0.77	0.02	
Unregulated Urban Impervious	TSS	11.71	234.2	3.57	835.64	847.44
Unregulated Urban Pervious		0.77	15.4	0.77	11.79	

Regulated FED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00
Unregulated Urban Pervious		0.03	0.6	0.00	0.00	
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.001	0.02	0.00	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.77	15.4	0.00	0.00	

Step 5

Calculate NET credits to MS4 from unregulated and other regulated lands

Adjustment for unregulated land

		Available Credit for Unregulated land	Baseline Reduction for Unregulated land	NET Credit Received for Unregulated land
Unregulated Land	TN	1.07	6.22	0.00
	TP	0.97	0.45	0.52
	TSS	638.05	480.25	157.80

Adjustment for other regulated land

		Available Credit for Other Regulated land	Baseline Reduction for Other regulated land	NET Credit Received for Unregulated land		TOTAL NET Credit Received for Other Regulated Land
Regulated APS	TN	1.27	8.59	0.00	TN	0.00
	TP	1.15	0.75	0.41	TP	0.41
	TSS	761.46	828.83	0.00	TSS	0.00
Regulated VDOT	TN	0.61	6.17	0.00		
	TP	0.55	0.73	0.00		
	TSS	363.84	847.44	0.00		
Regulated FED	TN	0.00	0.00	0.00		
	TP	0.00	0.00	0.00		
	TSS	0.00	0.00	0.00		

NET MS4 credit for stream restoration project

		Available Credit for Regulated land	NET Credit Received for Unregulated land	NET Credit Received for OTHER Unregulated land	Credit for Forest	NET Credit to MS4	
Regulated AC	TN	34.94	0.00	0.00	1.48	**36.43**	93%
	TP	31.68	0.52	0.41	1.35	**33.95**	95%
	TSS	20910.42	157.80	0.00	888.23	**21956.45**	93%

Urban Stream Restoration

Step 1:

Calculate the POC Reduction from the Proposed Stream Restoration Project:

Table V.H.1 - Urban Stream Restoration Interim Approved Removal Rates

BMP	How Credited	TN	TP	TSS
Stream Restoration	mass reduction/length(lbs/linear ft)	0.075	0.068	44.88
Tributary B	1355	101.625	92.14	60812.4

Step 2:

Characterize the Acres Draining to the Proposed Stream Restoration Project:

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated AC	23.92	38.06	61.98		
Regulated APS			0.00		
Regulated VDOT	0.92	0.04	0.96		
Regulated FED			0.00		
Unregulated Land	4.99	15.33	20.32	19.52	Total
		Total	83.26	19.52	102.78

Ratios of regulated, unregulated and forested acres to total acres

Regulated AC	0.60
Regulated APS	0.00
Regulated VDOT	0.01
Regulated FED	0.00
Unregulated Land	0.20
Forest Land	0.19

Step 3:

Calculate the Total Reduction for Regulated and Unregulated Urban Lands

Available credit is calculated by multiplying possible credit by the ratio calculated in step 2

		Possible Credit	Ratio	Available Credit
Regulated AC	TN	101.63	0.60	61.29
	TP	92.14	0.60	55.57
	TSS	60812.40	0.60	36673.69
Regulated APS	TN	101.63	0.00	0.00
	TP	92.14	0.00	0.00
	TSS	60812.40	0.00	0.00
Regulated VDOT	TN	101.63	0.01	0.95
	TP	92.14	0.01	0.86
	TSS	60812.40	0.01	566.73
Regulated FED	TN	101.63	0.00	0.00
	TP	92.14	0.00	0.00
	TSS	60812.40	0.00	0.00
Unregulated Land	TN	101.63	0.20	20.09
	TP	92.14	0.20	18.22
	TSS	60812.40	0.20	12023.23
Forest Land	TN	101.63	0.19	19.30
	TP	92.14	0.19	17.50
	TSS	60812.40	0.19	11548.75

Step 4:

Account for the Total Baseline Reduction on Unregulated land and Other Regulated land

UNREGULATED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Unregulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	4.99	7.98	17.18
Unregulated Urban Pervious		0.03	0.6	15.33	9.20	
Unregulated Urban Impervious	TP	0.01	0.2	4.99	1.00	1.30
Unregulated Urban Pervious		0.001	0.02	15.33	0.31	
Unregulated Urban Impervious	TSS	11.71	234.2	4.99	1168.66	1404.76
Unregulated Urban Pervious		0.77	15.4	15.33	236.10	

Regulated APS	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction	TOTALS
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00	1.50
Unregulated Urban Pervious		0.03	0.6	0.00	0.00		
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00	0.18
Unregulated Urban Pervious		0.001	0.02	0.00	0.00		
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00	216.24
Unregulated Urban Pervious		0.77	15.4	0.00	0.00		

Regulated VDOT	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.92	1.47	1.50
Unregulated Urban Pervious		0.03	0.6	0.04	0.02	
Unregulated Urban Impervious	TP	0.01	0.2	0.92	0.18	0.18
Unregulated Urban Pervious		0.001	0.02	0.04	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.92	215.67	216.24
Unregulated Urban Pervious		0.77	15.4	0.04	0.57	

Regulated FED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00
Unregulated Urban Pervious		0.03	0.6	0.00	0.00	
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.001	0.02	0.00	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.77	15.4	0.00	0.00	

Step 5

Calculate NET credits to MS4 from unregulated and other regulated lands

Adjustment for unregulated land

		Available Credit for Unregulated land	Baseline Reduction for Unregulated land	NET Credit Received for Unregulated land
Unregulated Land	TN	20.09	17.18	2.91
	TP	18.22	1.30	16.91
	TSS	12023.23	1404.76	10618.47

Adjustment for other regulated land

		Available Credit for Other Regulated land	Baseline Reduction for Other regulated land	NET Credit Received for Unregulated land		TOTAL NET Credit Received for Other Regulated Land
Regulated APS	TN	0.00	0.00	0.00	TN	0.00
	TP	0.00	0.00	0.00	TP	0.67
	TSS	0.00	0.00	0.00	TSS	350.49
Regulated VDOT	TN	0.95	1.50	0.00		
	TP	0.86	0.18	0.67		
	TSS	566.73	216.24	350.49		
Regulated FED	TN	0.00	0.00	0.00		
	TP	0.00	0.00	0.00		
	TSS	0.00	0.00	0.00		

NET MS4 credit for stream restoration project

		Available Credit for Regulated land	NET Credit Received for Unregulated land	NET Credit Received for OTHER Unregulated land	Credit for Forest	NET Credit to MS4	
Regulated AC	TN	61.29	2.91	0.00	19.30	**83.50**	82%
	TP	55.57	16.91	0.67	17.50	**90.65**	98%
	TSS	36673.69	10618.47	350.49	11548.75	**59191.41**	97%

Urban Stream Restoration

Step 1:

Calculate the POC Reduction from the Proposed Stream Restoration Project:

Table V.H.1 - Urban Stream Restoration Interim Approved Removal Rates

BMP	How Credited	TN	TP	TSS
Stream Restoration	mass reduction/length(lbs/linear ft)	0.075	0.068	44.88
Tributary A 1&2	1660	124.5	112.88	74500.8

Step 2:

Characterize the Acres Draining to the Proposed Stream Restoration Project:

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated AC	35.00	72.78	107.78		
Regulated APS	1.10	4.23	5.33		
Regulated VDOT	0.71	0.03	0.75		
Regulated FED	0.00	0.00	0.00		
Unregulated Land	0.05	1.63	1.68	5.32	Total
		Total	115.54	5.32	120.86

Ratios of regulated, unregulated and forested acres to total acres

Regulated AC	0.89
Regulated APS	0.04
Regulated VDOT	0.01
Regulated FED	0.00
Unregulated Land	0.01
Forest Land	0.04

Step 3:

Calculate the Total Reduction for Regulated and Unregulated Urban Lands

Available credit is calculated by multiplying possible credit by the ratio calculated in step 2

		Possible Credit	Ratio	Available Credit
Regulated AC	TN	124.50	0.89	111.03
	TP	112.88	0.89	100.66
	TSS	74500.80	0.89	66437.84
Regulated APS	TN	124.50	0.04	5.49
	TP	112.88	0.04	4.98
	TSS	74500.80	0.04	3286.30
Regulated VDOT	TN	124.50	0.01	0.77
	TP	112.88	0.01	0.70
	TSS	74500.80	0.01	461.31
Regulated FED	TN	124.50	0.00	0.00
	TP	112.88	0.00	0.00
	TSS	74500.80	0.00	0.00
Unregulated Land	TN	124.50	0.01	1.73
	TP	112.88	0.01	1.57
	TSS	74500.80	0.01	1035.79
Forest Land	TN	124.50	0.04	5.48
	TP	112.88	0.04	4.97
	TSS	74500.80	0.04	3279.56

Step 4:

Account for the Total Baseline Reduction on Unregulated land and Other Regulated land

UNREGULATED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Unregulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.05	0.08	1.06
Unregulated Urban Pervious		0.03	0.6	1.63	0.98	
Unregulated Urban Impervious	TP	0.01	0.2	0.05	0.01	0.04
Unregulated Urban Pervious		0.001	0.02	1.63	0.03	
Unregulated Urban Impervious	TSS	11.71	234.2	0.05	11.49	36.62
Unregulated Urban Pervious		0.77	15.4	1.63	25.12	

Regulated APS	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction	TOTALS
Unregulated Urban Impervious	TN	0.08	1.6	1.10	1.77	4.30	5.47
Unregulated Urban Pervious		0.03	0.6	4.23	2.54		
Unregulated Urban Impervious	TP	0.01	0.2	1.10	0.22	0.31	0.45
Unregulated Urban Pervious		0.001	0.02	4.23	0.08		
Unregulated Urban Impervious	TSS	11.71	234.2	1.10	258.58	323.68	491.41
Unregulated Urban Pervious		0.77	15.4	4.23	65.10		

Regulated VDOT	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.71	1.14	1.16
Unregulated Urban Pervious		0.03	0.6	0.03	0.02	
Unregulated Urban Impervious	TP	0.01	0.2	0.71	0.14	0.14
Unregulated Urban Pervious		0.001	0.02	0.03	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.71	167.19	167.72
Unregulated Urban Pervious		0.77	15.4	0.03	0.53	

Regulated FED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00
Unregulated Urban Pervious		0.03	0.6	0.00	0.00	
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.001	0.02	0.00	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.77	15.4	0.00	0.00	

Step 5

Calculate NET credits to MS4 from unregulated and other regulated lands

Adjustment for unregulated land

		Available Credit for Unregulated land	Baseline Reduction for Unregulated land	NET Credit Received for Unregulated land
Unregulated Land	TN	1.73	1.06	0.67
	TP	1.57	0.04	1.53
	TSS	1035.79	36.62	999.17

Adjustment for other regulated land

		Available Credit for Other Regulated land	Baseline Reduction for Other regulated land	NET Credit Received for Unregulated land		TOTAL NET Credit Received for Other Regulated Land
Regulated APS	TN	5.49	4.30	1.19	TN	1.19
	TP	4.98	0.31	4.67	TP	5.23
	TSS	3286.30	323.68	2962.62	TSS	3256.21
Regulated VDOT	TN	0.77	1.16	0.00		
	TP	0.70	0.14	0.56		
	TSS	461.31	167.72	293.59		
Regulated FED	TN	0.00	0.00	0.00		
	TP	0.00	0.00	0.00		
	TSS	0.00	0.00	0.00		

NET MS4 credit for stream restoration project

		Available Credit for Regulated land	NET Credit Received for Unregulated land	NET Credit Received for OTHER Unregulated land	Credit for Forest	NET Credit to MS4	
Regulated AC	TN	111.03	0.67	1.19	5.48	**118.37**	95%
	TP	100.66	1.53	5.23	4.97	**112.39**	100%
	TSS	66437.84	999.17	3256.21	3279.56	**73972.78**	99%

Urban Stream Restoration

Step 1:

Calculate the POC Reduction from the Proposed Stream Restoration Project:

Table V.H.1 - Urban Stream Restoration Interim Approved Removal Rates

BMP	How Credited	TN	TP	TSS
Stream Restoration	mass reduction/length(lbs/linear ft)	0.075	0.068	44.88
Tributary A 3&4	1230	92.25	83.64	55202.4

Step 2:

Characterize the Acres Draining to the Proposed Stream Restoration Project:

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated AC	59.10	111.59	170.69		
Regulated APS	1.15	4.78	5.93		
Regulated VDOT	1.56	0.15	1.71		
Regulated FED	0.00	0.00	0.00		
Unregulated Land	4.53	21.36	25.88	32.11	Total
		Total	204.21	32.11	236.32

Ratios of regulated, unregulated and forested acres to total acres

Regulated AC	0.72
Regulated APS	0.03
Regulated VDOT	0.01
Regulated FED	0.00
Unregulated Land	0.11
Forest Land	0.14

Step 3:

Calculate the Total Reduction for Regulated and Unregulated Urban Lands

Available credit is calculated by multiplying possible credit by the ratio calculated in step 2

		Possible Credit	Ratio	Available Credit
Regulated AC	TN	92.25	0.72	66.63
	TP	83.64	0.72	60.41
	TSS	55202.40	0.72	39871.61
Regulated APS	TN	92.25	0.03	2.31
	TP	83.64	0.03	2.10
	TSS	55202.40	0.03	1385.18
Regulated VDOT	TN	92.25	0.01	0.67
	TP	83.64	0.01	0.60
	TSS	55202.40	0.01	398.56
Regulated FED	TN	92.25	0.00	0.00
	TP	83.64	0.00	0.00
	TSS	55202.40	0.00	0.00
Unregulated Land	TN	92.25	0.11	10.10
	TP	83.64	0.11	9.16
	TSS	55202.40	0.11	6045.98
Forest Land	TN	92.25	0.14	12.54
	TP	83.64	0.14	11.37
	TSS	55202.40	0.14	7501.08

Step 4:

Account for the Total Baseline Reduction on Unregulated land and Other Regulated land

UNREGULATED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Unregulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	4.53	7.24	20.06
Unregulated Urban Pervious		0.03	0.6	21.36	12.81	
Unregulated Urban Impervious	TP	0.01	0.2	4.53	0.91	1.33
Unregulated Urban Pervious		0.001	0.02	21.36	0.43	
Unregulated Urban Impervious	TSS	11.71	234.2	4.53	1059.92	1388.82
Unregulated Urban Pervious		0.77	15.4	21.36	328.90	

Regulated APS	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction	TOTALS
Unregulated Urban Impervious	TN	0.08	1.6	1.15	1.84	4.71	7.29
Unregulated Urban Pervious		0.03	0.6	4.78	2.87		
Unregulated Urban Impervious	TP	0.01	0.2	1.15	0.23	0.33	0.64
Unregulated Urban Pervious		0.001	0.02	4.78	0.10		
Unregulated Urban Impervious	TSS	11.71	234.2	1.15	269.94	343.51	710.13
Unregulated Urban Pervious		0.77	15.4	4.78	73.57		

Regulated VDOT	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	1.56	2.49	2.58
Unregulated Urban Pervious		0.03	0.6	0.15	0.09	
Unregulated Urban Impervious	TP	0.01	0.2	1.56	0.31	0.31
Unregulated Urban Pervious		0.001	0.02	0.15	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	1.56	364.29	366.61
Unregulated Urban Pervious		0.77	15.4	0.15	2.32	

Regulated FED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00
Unregulated Urban Pervious		0.03	0.6	0.00	0.00	
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.001	0.02	0.00	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.77	15.4	0.00	0.00	

Step 5

Calculate NET credits to MS4 from unregulated and other regulated lands

Adjustment for unregulated land

		Available Credit for Unregulated land	Baseline Reduction for Unregulated land	NET Credit Received for Unregulated land
Unregulated Land	TN	10.10	20.06	0.00
	TP	9.16	1.33	7.83
	TSS	6045.98	1388.82	4657.17

Adjustment for other regulated land

		Available Credit for Other Regulated land	Baseline Reduction for Other regulated land	NET Credit Received for Unregulated land		TOTAL NET Credit Received for Other Regulated Land
Regulated APS	TN	2.31	4.71	0.00	TN	0.00
	TP	2.10	0.33	1.77	TP	2.06
	TSS	1385.18	343.51	1041.66	TSS	1073.61
Regulated VDOT	TN	0.67	2.58	0.00		
	TP	0.60	0.31	0.29		
	TSS	398.56	366.61	31.94		
Regulated FED	TN	0.00	0.00	0.00		
	TP	0.00	0.00	0.00		
	TSS	0.00	0.00	0.00		

NET MS4 credit for stream restoration project

		Available Credit for Regulated land	NET Credit Received for Unregulated land	NET Credit Received for OTHER Unregulated land	Credit for Forest	NET Credit to MS4	
Regulated AC	TN	66.63	0.00	0.00	12.54	**79.17**	86%
	TP	60.41	7.83	2.06	11.37	**81.67**	98%
	TSS	39871.61	4657.17	1073.61	7501.08	**53103.46**	96%

Urban Stream Restoration

Step 1:

Calculate the POC Reduction from the Proposed Stream Restoration Project:

Table V.H.1 - Urban Stream Restoration Interim Approved Removal Rates

BMP	How Credited	TN	TP	TSS
Stream Restoration	mass reduction/length(lbs/linear ft)	0.075	0.068	44.88
Headwaters	480	36	32.64	21542.4

Step 2:

Characterize the Acres Draining to the Proposed Stream Restoration Project:

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated AC	8.84	9.37	18.21		
Regulated APS			0.00		
Regulated VDOT	0.84	0.11	0.95		
Regulated FED			0.00		
Unregulated Land	1.25	5.28	6.53	19.52	Total
		Total	25.69	19.52	45.21

Ratios of regulated, unregulated and forested acres to total acres

Regulated AC	0.40
Regulated APS	0.00
Regulated VDOT	0.02
Regulated FED	0.00
Unregulated Land	0.14
Forest Land	0.43

Step 3:

Calculate the Total Reduction for Regulated and Unregulated Urban Lands

Available credit is calculated by multiplying possible credit by the ratio calculated in step 2

		Possible Credit	Ratio	Available Credit
Regulated AC	TN	36.00	0.40	14.50
	TP	32.64	0.40	13.15
	TSS	21542.40	0.40	8677.18
Regulated APS	TN	36.00	0.00	0.00
	TP	32.64	0.00	0.00
	TSS	21542.40	0.00	0.00
Regulated VDOT	TN	36.00	0.02	0.76
	TP	32.64	0.02	0.69
	TSS	21542.40	0.02	452.68
Regulated FED	TN	36.00	0.00	0.00
	TP	32.64	0.00	0.00
	TSS	21542.40	0.00	0.00
Unregulated Land	TN	36.00	0.14	5.20
	TP	32.64	0.14	4.71
	TSS	21542.40	0.14	3111.59
Forest Land	TN	36.00	0.43	15.54
	TP	32.64	0.43	14.09
	TSS	21542.40	0.43	9300.96

Step 4:

Account for the Total Baseline Reduction on Unregulated land and Other Regulated land

UNREGULATED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Unregulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	1.25	2.00	5.17
Unregulated Urban Pervious		0.03	0.6	5.28	3.17	
Unregulated Urban Impervious	TP	0.01	0.2	1.25	0.25	0.36
Unregulated Urban Pervious		0.001	0.02	5.28	0.11	
Unregulated Urban Impervious	TSS	11.71	234.2	1.25	292.75	374.06
Unregulated Urban Pervious		0.77	15.4	5.28	81.31	

Regulated APS	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction	TOTALS
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00	1.41
Unregulated Urban Pervious		0.03	0.6	0.00	0.00		
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00	0.17
Unregulated Urban Pervious		0.001	0.02	0.00	0.00		
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00	198.42
Unregulated Urban Pervious		0.77	15.4	0.00	0.00		

Regulated VDOT	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.84	1.34	1.41
Unregulated Urban Pervious		0.03	0.6	0.11	0.07	
Unregulated Urban Impervious	TP	0.01	0.2	0.84	0.17	0.17
Unregulated Urban Pervious		0.001	0.02	0.11	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.84	196.73	198.42
Unregulated Urban Pervious		0.77	15.4	0.11	1.69	

Regulated FED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Unregulated land draining to stream restoration project	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00
Unregulated Urban Pervious		0.03	0.6	0.00	0.00	
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.001	0.02	0.00	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.77	15.4	0.00	0.00	

Step 5

Calculate NET credits to MS4 from unregulated and other regulated lands

Adjustment for unregulated land

		Available Credit for Unregulated land	Baseline Reduction for Unregulated land	NET Credit Received for Unregulated land
Unregulated Land	TN	5.20	5.17	0.03
	TP	4.71	0.36	4.36
	TSS	3111.59	374.06	2737.52

Adjustment for other regulated land

		Available Credit for Other Regulated land	Baseline Reduction for Other regulated land	NET Credit Received for Unregulated land		TOTAL NET Credit Received for Other Regulated Land
Regulated APS	TN	0.00	0.00	0.00	TN	0.00
	TP	0.00	0.00	0.00	TP	0.52
	TSS	0.00	0.00	0.00	TSS	254.26
Regulated VDOT	TN	0.76	1.41	0.00		
	TP	0.69	0.17	0.52		
	TSS	452.68	198.42	254.26		
Regulated FED	TN	0.00	0.00	0.00		
	TP	0.00	0.00	0.00		
	TSS	0.00	0.00	0.00		

NET MS4 credit for stream restoration project

		Available Credit for Regulated land	NET Credit Received for Unregulated land	NET Credit Received for OTHER Unregulated land	Credit for Forest	NET Credit to MS4	
Regulated AC	TN	14.50	0.03	0.00	15.54	**30.08**	84%
	TP	13.15	4.36	0.52	14.09	**32.11**	98%
	TSS	8677.18	2737.52	254.26	9300.96	**20969.92**	97%

Step 1

Characterize the Acres and Loads Draining to the Retrofit

BALLSTON POND

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Impervious LOADS (per DCR Potomac River Basin) TN	TP	TSS	Pervious LOADS (per DCR Potomac River Basin) TN	TP	TSS	Total Load to retrofit TN	TP	TSS
Regulated AC	182.73	211.52	394.25	3080.8	296.0	214035.3	2130.0	86.7	37185.2	**5210.8**	**382.7**	**251220.5**
Regulated APS	4.60	5.10	9.69	77.5	7.4	5385.1	51.3	2.1	896.1	**128.8**	**9.5**	**6281.1**
Regulated VDOT	18.31	9.13	27.43	308.6	29.7	21442.6	91.9	3.7	1604.3	**400.5**	**33.4**	**23046.9**
Regulated FED			0.00	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**
Unregulated Land	6.79	12.84	19.63	114.4	11.0	7950.0	129.3	5.3	2257.0	**243.7**	**16.3**	**10207.0**
	212.42	238.58	451.00									

Step 2

Calculate retrofit removal rates and loads removed

		REMOVAL RATES per adjustor curves		
Retrofit storage vol (ac-ft)	Runoff depth treate	TN	TP	TSS
6	0.34	**20%**	**32%**	**41%**

Design plans provide 6.8 ac-ft volume. Lower value used here to be conservative, and as-built data will document actual value, with computations updated accordingly.

Calculate total loads removed for Regulated and Unregulated lar	TN	TP	TSS
Regulated AC	1064.0	122.8	102616.7
Regulated APS	26.3	3.1	2565.7
Regulated VDOT	81.8	10.7	9414.0
Regulated FED	0.0	0.0	0.0
Unregulated Land	49.8	5.2	4169.3
	1221.9	**141.8**	**118765.7**

Step 3

Account for the Total Baseline Reduction on Unregulated land and Other Regulated land

UNREGULATED	**Pollutant**	**2009 EOSLoading Rate (lbs/ac)**	**Loading Rate for Unregulated land**	**Unregulated land draining to retrofit**	**Total required baseline reduction**	**Total required baseline reduction**	**TOTALS**
Unregulated Urban Impervious	TN	0.08	1.6	6.79	10.86	18.56	63.74
Unregulated Urban Pervious		0.03	0.6	12.84	7.70		
Unregulated Urban Impervious	TP	0.01	0.2	6.79	1.36	1.61	6.48
Unregulated Urban Pervious		0.001	0.02	12.84	0.26		
Unregulated Urban Impervious	TSS	11.71	234.2	6.79	1589.56	1787.27	7370.37
Unregulated Urban Pervious		0.77	15.4	12.84	197.71		

Regulated APS	**Pollutant**	**2009 EOSLoading Rate (lbs/ac)**	**Loading Rate for Other Regulated land**	**Other regulated land draining to retrofit**	**Total required baseline reduction**	**Total required baseline reduction**
Unregulated Urban Impervious	TN	0.08	1.6	4.60	7.36	10.41
Unregulated Urban Pervious		0.03	0.6	5.10	3.06	
Unregulated Urban Impervious	TP	0.01	0.2	4.60	0.92	1.02
Unregulated Urban Pervious		0.001	0.02	5.10	0.10	
Unregulated Urban Impervious	TSS	11.71	234.2	4.60	1076.72	1155.22
Unregulated Urban Pervious		0.77	15.4	5.10	78.49	

Regulated VDOT	**Pollutant**	**2009 EOSLoading Rate (lbs/ac)**	**Loading Rate for Other Regulated land**	**Other regulated land draining to retrofit**	**Total required baseline reduction**	**Total required baseline reduction**
Unregulated Urban Impervious	TN	0.08	1.6	18.31	29.29	34.77
Unregulated Urban Pervious		0.03	0.6	9.13	5.48	
Unregulated Urban Impervious	TP	0.01	0.2	18.31	3.66	3.84
Unregulated Urban Pervious		0.001	0.02	9.13	0.18	

Unregulated Urban Impervious	TSS	11.71	234.2	18.31	4287.34	4427.88
Unregulated Urban Pervious		0.77	15.4	9.13	140.54	

Regulated FED	Pollutant	2009 EOSLoading Rate (lbs/ac)	Loading Rate for Other Regulated land	Other regulated land draining to retrofit	Total required baseline reduction	Total required baseline reduction
Unregulated Urban Impervious	TN	0.08	1.6	0.00	0.00	0.00
Unregulated Urban Pervious		0.03	0.6	0.00	0.00	
Unregulated Urban Impervious	TP	0.01	0.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.001	0.02	0.00	0.00	
Unregulated Urban Impervious	TSS	11.71	234.2	0.00	0.00	0.00
Unregulated Urban Pervious		0.77	15.4	0.00	0.00	

Step 4
Calculate net credit to MS4

	TN	TP	TSS
Total loads removed by retrofit	1221.9	141.8	118765.7
Baseline reductions required for other regulated and unregulated	63.74	6.48	7370.37
	1158.1	**135.3**	**111395.3**

Appendix D
STREAM RESTORATION AND LARGE SCALE PROJECTS COMPUTATIONS
URBAN STREAM RESTORATION INTERIM REMOVAL RATES AND
ADJUSTOR CURVE METHOD WITH MS4 PERMIT LOADING RATES

Potential Reductions

Shoreline Management

Summary of Pollutant Load Reductions

Protocol	Name	Units	Pollutants	Reduction Rate	Applicable?
1	Prevented Sediment	pounds per year	Sediment	Measured TSS in sediment prevented. Calculated based on shoreline erosion with reductions for sand content and bank instability.	NO
2	Denitrification	pounds per year	TN	Measured TN removal for denitrification rate wassociated with vegetated area. 85 lbs TN/acre/yr	YES
3	Sedimentation	pounds per year	Sediment, TP	Measured TSS and TP removal rates assocaited with vegetated area. 6,959 lbs TSS/acre/yr. 5.289 lbs TP/acre/yr	YES
4	Marsh Redfield Ratio	pounds per year	TN, TP	Measured TN and TP removal rates assocaited with vegetated area. 6.83 lbs TN/acre/yr. 0.3 lbs TP/acre/yr	YES
5	Default Rate	pounds per year	TSS	164 lbsTSS/fl/yr MD, DE, DC. 42 lbs TSS/lf/yr VA	NO

Total Year 1 Reductions

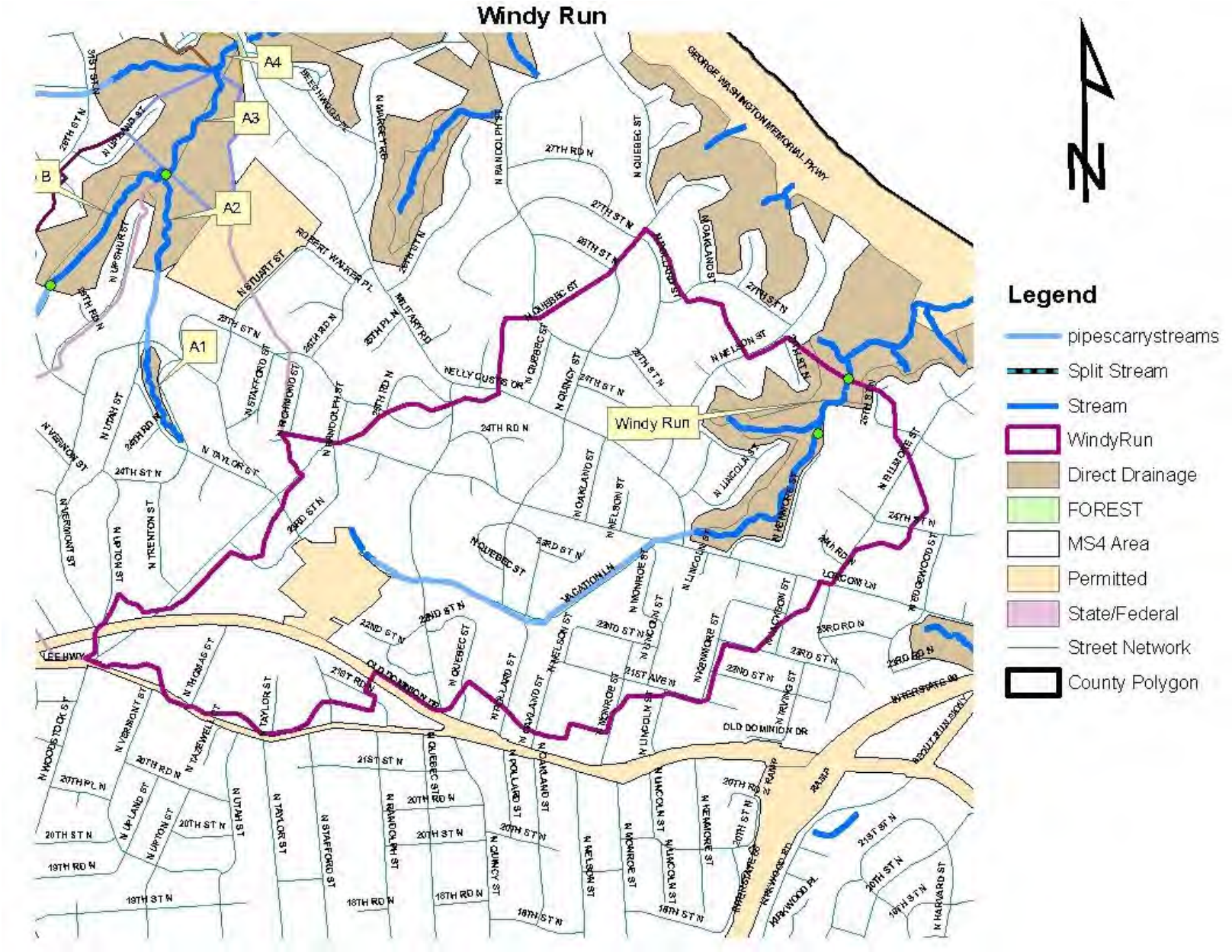
Pollutant	Protocol 1	Protocol 2	Protocol 3	Protocol 4	Year 1 Total Pollutant Load Reduction (lbs/yr)
TN	NA	48.45	NA	3.8931	52.34
TP	NA	NA	3.01473	0.171	3.19
TSS	NA	NA	3966.63	NA	3966.63

For more detail information on calculations see Stream restoration and large scale facilities spreadsheet.

Sparrow Pond

No calculations for Sparrow pond are provided because an existing conditions survey is planned to document and compare the facility's current volume to the design volume and then to compute the incremental POC reduction credits that could result from restoring the design volume (and maintaining it over time).

APPENDIX E
STREAM RESTORATION AND LARGE SCALE PROJECTS BASIN MAPS



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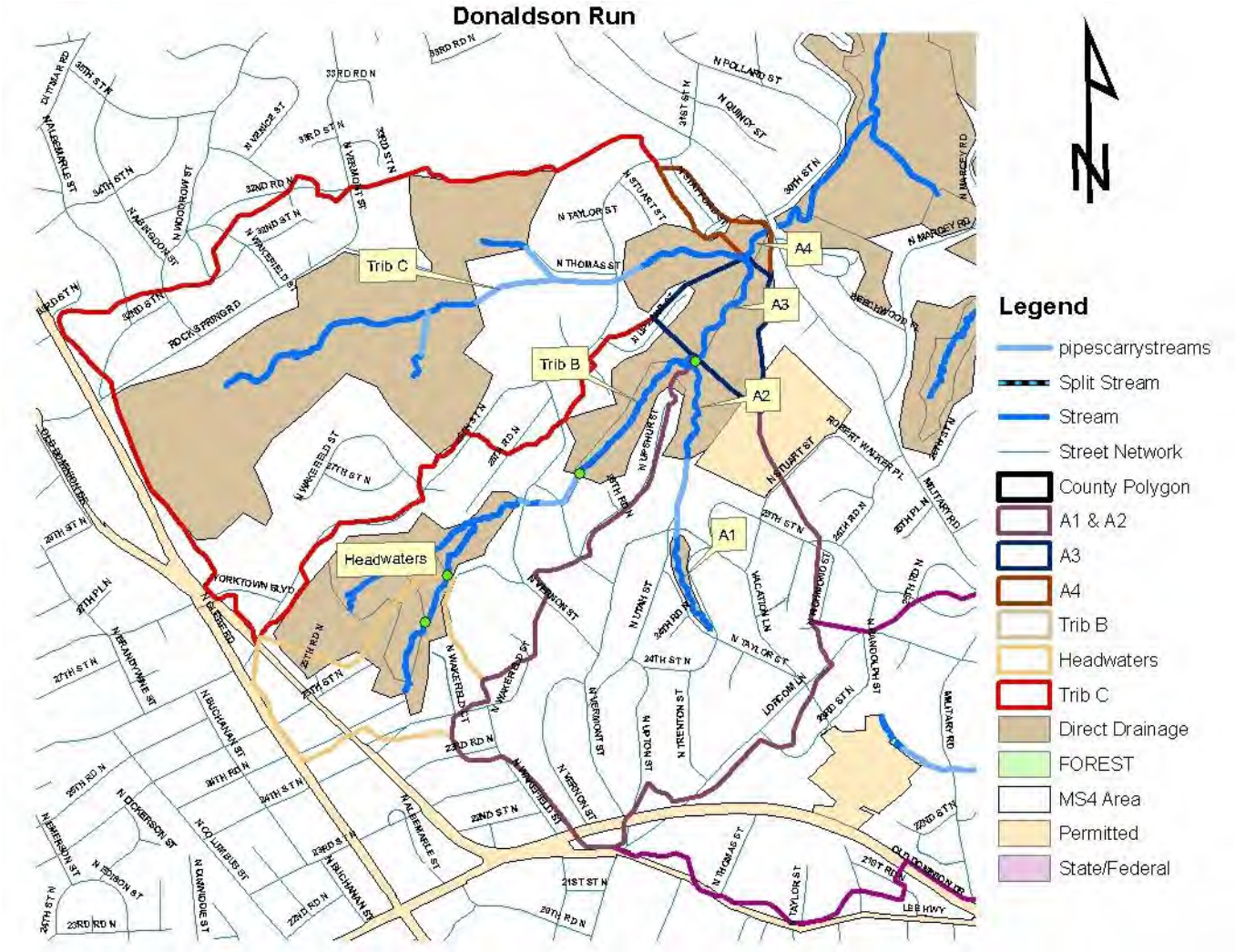

APPENDIX E
STREAM RESTORATION AND LARGE SCALE PROJECTS BASIN MAPS

Drainage basin for Tributary B include headwaters. Drainage basin for Tributary A 3&4 includes, Tributary B, headwaters and Tributaries A 1&2 and A3&4. The basin for Tributary C was excluded from the area used in calculation for Tributary A 3&4 because the reach of the stream affected by the basin is so small relative to size of the basin.

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STREAM RESTORATION AND LARGE SCALE PROJECTS BASIN MAPS